Universal Journal of Environmental Research and Technology
 eISSN 2249 0256
Available Online at: **www.environmentaljournal.org**
2013 Volume 3, Issue 6:660-666

Open Access **Research Article**

Seasonal Variations in Physico-Chemical Parameters of Water Body Amghass II Province Ifrane Morocco

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Abstract: Water quality of body water Amghass II in province Ifrane Morocco recognized for sport fishing of rainbow trout, was assessed in terms of their physicochemical parameters. The aim of this research was to study the seasonal variations of physicochemical parameters in this water bodie. Samples were collected on the monthly basis since October 2004 to September 2005, from three sites were chosen in water body. Temperature, transparency, pH, conductivity, dissolved oxygen, nitrate, nitrite and phosphate, were analyzed monthly during one year using standard methods and procedures. The ranges of these factors were found to be comparable to those reported for other.The study concludes that water body has excellent water quality, high ecological status. The body water Amghass II demonstrate good water quality and can always classify the waters from the waters first class salmonid vocation. These features offer for rainbow trout a favorable ecological environment for growth.

Keywords: Amghass, freshwater, physico-chemical parameters, water bodies.

1.0 Introduction:

Morocco is the only country recognized to North Africa which enjoys a river and lake water system highly developed, this aquatic system is powered mainly from by the cold waters of high mountains of the Middle and High Atlas. Among the regions of Morocco with a wealth of natural lakes and atrificiels the Ifrane province. The rainbow trout species was introduced into inland waters of Morocco in 1924 (Mouslih 1987; Ibn Majdoub et al, 2002. These artificial lake in this province, Amghass II recognized by sport fishing rainbow trout in Morocco. Sport fishing species, including rainbow trout, have been introduced into water bodies to improve the biodiversity of the environment (Cambray, 2003; Mouslih 1987).

Water quality parameters can be divided into three main categories: physical (density, temperature); chemical (pH, conductivity, nutrients) and biological (bacteria, plankton and parasites) (Delince, 1992 and Moody, 2005). All living organisms have tolerable limits of water quality parameters in which they live and grow optimally. A sharp drop or an increase within these limits has adverse effects on their body functions (Davenport, 1993). Fresh water contains various organisms and micro-organism. The quality (physico-chemical) of water affects to species composition, abundance and productivity of water of these organisms which include fishes. Physical and chemical parameters are directly related to fish and productivity of water bodies (Sidnei, et al,.1992). The physico-chemical parameters affecting aquatic environment which are supposed to be the limiting factors for the continued existence of aquatic life of flora and fauna (Chitmanat and Traichaiyaporn, 2010), the study aimed to investigate physical-chemical parameters in the River and the heavy metal contamination in freshwater.

Some fishes can survive in a wide range of condition and some are more tolerant to pollution and other are very sensitive to change in conditions and are intolerant to pollution, among these fish is the salmon family represented by the rainbow trout, fish very sensitive to changes in environmental conditions in aquatic environments. The water quality of rivers and lakes changes with the seasons, geographic areas, even when there is no pollution present. Water quality guidelines provide basic scientific information about water quality parameters and ecologically relevant

toxicological threshold values to protect organism's water users. (Chitmanat and Traichaiyaporn, 2010). Freshwater fish are one of the most threatened taxonomic groups (Dudgeon et al, 2006), because of their high sensitivity to the quantitative and qualitative alteration of aquatic habits (Lafaille et al, .2005). The biology, ecology and physicochemical characteristics of this aquatic habitats have been studied in Morocco by, zraouti (1993) and Ibn Elmajdoub (2002). Further, studies on comparison of pattern of monthly variation in physicochemical parameters for one year might reveal whether changes are seasonal fluctuations or due to other factors. Present study aims at investigating seasonal variations if any, in physicochemical water quality parameters, and if so, whether or not they are within desirable limits for rainbow trout live.

2.0 Materials and Methods:

2.1 Study area and sampling sites

The water body Amghass II, is located in Central Middle Atlas at Province Ifrane, 26 Km from the city of Azrou at an altitude of 970m, longitude 33°23' N and latitude 5°27'W , created for sport fishing of rainbow trout at 1954 (this fish was introduced in Morocco in 1924) , with the surface area is 3.10 hectares with a length of 450m and a perimeter of 1100m with a maximum depth of 3.10 m. This lake has several water sources whose flow is 600litres/seconds. The net water storage capacity of this artificial lake is 48,000 m3 and the water retention time is 22 days .

Sampling points were decided by keeping in mind that the considered sampling points must include shallow and deep regions of the water body. Water samples were collected from three sampling stations for To study the changes of the physicochimical parameters, regular samplings of water were done fortnightly during october, 2004 – September 2005, samples were collected from three stations along a gradient "upstream-downstream".

2.2 Water Quality Monitoring

Bimonthly sampling was conducted from October 2004 to September 2005 (before and after treatment) at the same hour of each sampling day. Water samples for chemical analysis were collected from the middle of the water column in triplicate using prewashed polyethylene bottles and were carried to the laboratory at +4°C and analyzed within 24h.

2.3 Analytical Methods

For the study of water quality parameters, water samples were collected from three different sampling sites of the wetland every ten **15** days interval. The methodology adopted for the analysis of water samples were:

a . Air temperature: Mercury thermometer graduated up to 110°C.

b. Water temperature: Orion model 260

c. Transparency: by Secchi disc of 30 cm diameter.

d. pH : the potential of hydrogen (pH), by a pH meter Orion type model 260

e. Dissolved Oxygen (DO), measured by oximetry type Orion, model 3301, determined immediately at the site.

f. Electric Conductivity by a conductivity meter type Orion, model 130.

For these parameters the measurements were made in situ. Other variables, Total Phosphorus, nitrite, nitrate were analysed in the laboratory of Water Quality, at National Center of Hydrobiology and Fish Farm (CNHF) in the Azrou City (Morocco), were determined separately, for three samples, in the laboratory, employing methods described in APHA (1998).

3.0 Results and Discussion

Variation of physico-chemical parameters of water body Amghass II is depicted in the Tables 1 to 4.

3.1Transparency

Monitoring the transparency shows significant seasonal variations. The depth of disappearance of the Secchi disk is between a minimum of 0.90 m and a maximum of 3.10 m. The lower values indicating a low level of transparency coincide with the season of flood and rain during the winter season .Water transparency determines the depth of the photic zone and consequently affects the lower limit of light penetration that influences the primary productivity of a lake. Plankton also reduces transparency in natural waters (Ramachandra and Solanki, 2007). Secchi disk transparency is essentially a function of the reflection of light from its surface and is therefore influenced by the absorption characteristics both of the water and of its dissolved and particulate matter. Transparency measured Secchi disk is high (3.10 m) across the water and the waters are characterized by an abscence of turbidity at spring and summer seasons. The values obtained in this study agree well with the zraouti (1993) and Ibn Majdoub (2002).

3.2 Air temperature

Air temperature varied between 3, 56 **ºC** and 38,43 ºC . The mean air temperature was highest in summer and lowest in winter. According to Welch (1952) smaller the body of water, more quickly it reacts to changes in the atmospheric temperature. The water bodies operate as the cooling source on the microclimate of the surrounding area. Air temperature near or over bodies of water is much different from that over land due to differences in the way water heat and cool (Wong et al, 2012). Air temperature is determined by the air masses over the particular land mass, climatic condition (Hutchinson, 1967), time of sample collection, climate and solar radiation and topography, have an impact on air temperature Kant and Raina (1990). The values recorded in this study show a significant change in temperature, its level has fluctuated due to the seasonal effect of winter and summer. In addition, this body of water is surrounded by a mountain range that had a effect on temperature. The recorded temperature in winter can be explained by the snowfall on the day of sampling.

Table 1: Physico-chemical parameters of summer season

Parameters	**Summer season**
Air temperature (°C)	38,43
Water temperature	19,21
pH	7,98
DO ($mg.l^{-1}$)	10,43
Conductivity ($\mu m.cm^{-1}$)	683,16
Nitrites ($mg.l^{-1}$)	0,01- 0,021
Nitrates ($mg.l^{-1}$)	0,24
Phosphates ($mg.l^{-1}$)	0,05

Table 2: Physico-chemical parameters of spring season

Parameters	**spring season**
Air temperature (°C)	16,45
Water temperature	12,78
pH	8,38
DO ($mg.l^{-1}$)	8,38
Conductivity ($\mu m.cm^{-1}$)	671,13
Nitrites ($mg.l^{-1}$)	0,021
Nitrates ($mg.l^{-1}$)	5,21
Phosphates ($mg.l^{-1}$)	0,11

Table 3: Physico-chemical parameters of automn season

Parameters	**autumn season**
Air temperature (°C)	14,35
Water temperature	11,21
pH	7,14
DO ($mg.l^{-1}$)	8,88
Conductivity ($\mu m.cm^{-1}$)	666,78
Nitrites ($mg.l^{-1}$)	0,012
Nitrates ($mg.l^{-1}$)	0,13
Phosphates ($mg.l^{-1}$)	0,02

Table 4: Physico-chemical parameters of winter season.

Parameters	**Winter Season**
Air temperature (°C)	3,56
Water temperature	8,72
pH	7,74
DO ($mg.l^{-1}$)	11,07
Conductivity ($\mu m.cm^{-1}$)	653,21
Nitrites ($mg.l^{-1}$)	0,01
Nitrates ($mg.l^{-1}$)	0,14
Phosphates ($mg.l^{-1}$)	0,02

3.3 Water temperature

The analytical results of the present investigation indicate that the quality of water considerably varies by seasons. Temperature of the water at different sites varied between 8,72°C and 19,21°C. Water temperature is of enormous significance as it regulates various abiotic characteristics and activities of an aquatic ecosystem (Hutchinson, 1957; Alabaster and Lloyd, 1980; Kataria et al., 1995; Singh and Mathur, 2005; Ramchandra and Solanki, 2007). The temperature of the living environment is a primary ecological factor acts on the biology and behavior of trout (Gouraud et al., 1999). Does not control the temperature of their environment and their bodies, trout have a metabolism that is determined by the water temperature, it accelerates with increasing temperature and slows down when temperature decrease.(Belkovskiy et al, 1991). Temperature is the most often tested variable in many fish studies, including studies involving trout. Temperature is also critical for trout survive and grow best in cool water 5 °C to less than 20 °C , during summer , approaching a potentially critical temperature for trout survival (Currie et al. 1998). Rainbow trout (*Onchorhnychus mykiss*) can tolerate water temperatures of between 0 and 26°C, however, growth and reproduction will only

take place in colder waters (between 9 and 14°C) (Bidgood, 1980); (FAO 2012). Based on available literature drawn largely from different studies (Currie et al. 1998, Myrick and Cech, 2001) the upper incipient lethal temperature for rainbow trout is within the range 25 to 30°C. Bidgood, (1980), Finstad et al, (1988), Zraouti (1993), Rowe and Chisnall, (1995), Ibn Majdoub et al, (2002) whose works were on rainbow trout, , and Elliott et al, (1995) for Atlantic salmon and brown trout. It is remarkable to observe that the water temperature of the bodie water is comparable to that of air and follows the same variations.

3.4 pH (potentia Hydrogenii)

The winter to the summer season , the pH is high, greater than or equal to 8. He then lowered to be below this value the second part of the year. In general, the pH values are proportional to those of the dissolved oxygen. More water is oxygenated, it is more basic. The pH value of some samples were found to be in the range between 7.74 and 8.38 indicating alkalinity dominance on this water. Hydrogen ions as well as hydroxyl ions are the result of the ionization of water. Any change in the concentration of any one of these ions bring about a change in the concentration of the other. The pH of the water bodie indicate the alkaline nature of water and it varies from 7.74 to 8.38. The pH of water is important because many biological activities can occur only within a narrow range. Thus all variation beyond acceptable range could be fatal to a particular organism (Grande and et al, 1978, Slingsby and Cook 1986). The favorable range of pH is 6.5-9.0, are most suitable for rainbow trout. Although the tolerance of individual species varies, pH values between 7.74 and 8.38 usually indicate good water quality and this range is typical of most major water bodies of the world. Thus it appears this research shown the pH tolerances of trout at all life stages, of this fish, because this water bodies contains trout of all ages. the same results were obtained by Audet, and Wood(1988), Zraouti (1993), Ibn Majdoub et al, (2002) , Caldwell and Hinshaw (1995) and Neary (2008), and Elliott et al, (1995) , for Atlantic salmon and brown trout.

3.5 DO (Dissolved Oxygen)

Dissolved Oxygen concentration (DO) of the water varied from to 8.98 mg/l to 11,07 mg/l. Dissolved oxygen is essential to the respiratory metabolism of most aquatic organisms. The dynamics of oxygen distribution in inland waters of aquatics systems are governed by a balance between inputs from the atmosphere and photosynthesis and losses from the chemical and biotic oxidations. DO is a very important parameter for the survival of fishes, especially rainbow trout, a species very demanding for oxygen dissolved in water. Dissolved oxygen in general affects the solubility and activity of various nutrients and therefore, the productivity of an aquatic ecosystem (Wetzel, 1983). Dissolved oxygen is the most important chemical parameter in fish life. Low dissolved oxygen levels are responsible for more fish kills, either directly or indirectly, and then all other problems combined. Oxygen concentration has been identified as the critical factor for the survival of O.mykiss. (Rubin 1998). Dissolved oxygen is essential for the life of the rainbow trout. This fish is considered a very demanding species of this element (Huet, 1962, Baglinière and Maisse ,1991). Wedemeyer (Wedemeyer, 1996) suggested than 5-6 mg/l is too low to have a safety margin if fish need more oxygen due to increased activity (digestion, swimming, stress). The temperature of the water affects many other parameters. This is primarily the case for Dissolved Oxygen necessary for aquatic life: The higher the water temperature rises, the greater the amount of dissolved oxygen decreases (Currie et al. 1998). These results of this study are consistent with those for Wetzel (1983), Zraouti (1993), Caldwell and Hinshaw (1995), Matthews, and Berg,. 1997, Ibn Majdoub et al, (2002). The high values of dissolved oxygen during the seasons of winter and summer can be attributed to the water temperature and photosynthetic activity. The high concentration of dissolved oxygen in the water body could be attributed to low organic enrichment.

3.6 Electrical Conductivity (EC)

The electric conductivity varies from 653,21 – 683,16 $\mu m.cm^{-1}$ . .Electrical Conductivity (EC) in natural waters is the normalized measure of the water's ability to conduct electric current. The conductivity measurement is a fairly simple way of detecting an anomaly indicating the likely presence of contamination (pollution). Dissolved salts exert osmotic pressure on organisms. strong variations cause mortality. A surge may cause gill cell damage (Caudron, 2006). Recommended for trout values are between 150 µm / cm and 750 µm / cm(Caudron, 2006). Changes in the electrical conductivity depend largely on the flow of water of the artificial lake, and mineralization of organic matter. Minor fluctuations may be due to slight variations in temperature and low rainfall during the summer season .While the recorded values are between 653.21 to 683.16 µm.cm-1, which shows that our results meet the standards of salmonids.

3.7 Nitrite (NO2)

For nitrites the values were be in the range between 0,01- 0,021 $mg.l^{-1}$. Nitrite is an intermediate stage in oxidation of nitrogen, both the oxidation of ammonia to nitrate as well as in reduction of nitrate (Williams and Eddy 1986; Kroupova et al, 2005). Toxicity of nitrite depends on water chemistry. Nitrite levels above 0.1 mg/l $NO2^{-1}$ in water can be toxic (Wedemeyer, 1996). It has long been known that the nitrite ions penetrate into fish through the chloride cells in gills. In the blood of fish nitrites are closely related to hemoglobin structure resulting in reduced transportation of the oxygen capacity of the blood.(Avkhimovich, 2013). However, very high concentrations, particularly combined with low pH and high temperatures, results in eutrophication and may limit oxygen levels or act as a direct toxin to trout, especially in the form of nitrite. (Brown and McLeay, 1975). The main source of nitrate is the run-off and decomposition of organic matter. The higher inflow of water and consequent land drainage cause high value of nitrate in bodie water. The values recorded during this study shows that this water has levels that meet the standards of salmonids fish. The high values of 0.021 mg / l recorded at spring season, are due to fertilizer agricultural fields that were near the water bodies. These values agree well with those of Zraouti 1993, Ibn Majdoub 2002, and are also consistent with those of Lwama and (2000). indicating that this water gives trout a good quality water that meets the standards of salmonids.The toxic effects of nitrite for rainbow trout are from 0.1 mg / l (Caudron, 2006).

3.8 Nitrate (NO^{3-})

Nitrate concentration in the present study varied from 0.14 to 5,21 mg/L of which higher value (5,21 mg/L) was observed in spring season while the lower value (0,14 mg/L) in winter season. .Nitrate is the most highly oxidized form of nitrogen compound commonly present in natural waters. It is a product of aerobic decomposition of organic nitrogenous matter. Nitrate is far less toxic than ammonia, with nitrite being the most toxic nitrogenous compound to fishes in freshwater (Westin 1974). Ammonium tends to be oxidized to nitrate by aerobic chemoautotrophic bacteria (*Nitrosomonas and Nitrobacter,*) (Stumm and Morgan, 1996; Wetzel, 2001). In consequence, concentrations of nitrate in freshwater ecosystems usually are higher than those of ammonium and nitrite (Camargo et al., 2004). Nitrate may however be removed from water by aquatic plants, algae and bacteria which assimilate it as a source of nitrogen (Smith et al., 1999; Wetzel, 2001). The results obtained in this study shows that this water meets the salmonid fish. These values obtained are consistent with those of zraouti(1993) and Ibn Majdoub(2002). Furthermore, a maximum level of 2 mg NO^{3-} would be appropriate for protecting the most sensitive freshwater species such as rainbow trout (Camargo et al, 2005). The high values recorded can be attributed to fertilizers used by farmers and their runoff into this artificial lake.

3.9 Phosphates

As for phosphates results are of the order of 0,02 – 0,11 mg.l-1 .Willem et al. (1972) found that total phosphate was always higher at the polluted points in comparison to non-polluted points of the water bodies. It is to be noted that concentration of phosphate, a key nutrient responsible for eutrophication remained low and phytoplankton diversity was more during majority of months The increase in the value of phosphate at spring season in bodie water, is mainly because of the run-off from catchment area including some agricultural fields, which are located near this body water. Effects of nuisance for rainbow trout are from 0.3 mg / l (Caudron, 2006). The values obtained for phosphates indicate that the water body meets to the standards values of salmonids.

4.0 Conclusion

After this study we note that all the physico-chemical parameters, further, although majority of these parameters were in normal range in majority of months, for rainbow trout. The water quality and therefore its productivity and fish vocation depend on a number of conventional quality descriptors physical and chemical study of the water environment. Monitoring of all parameters for the life of salmonids such as temperature, dissolved oxygen levels, the potential hydrogen (pH) and nitrite water from the water Amghass II demonstrate good water quality and can always classify the waters from the waters first class salmonid vocation. These features offer for rainbow trout a favorable ecological environment for growth.

5.0 Acknowledgements

We express our sincere thanks to the National Center of Hydrobiology and Fish-Culture (NCHF) Azrou for its support and providing necessary facilities.

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